



(11) **EP 1 227 016 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
31.07.2002 Bulletin 2002/31

(51) Int Cl.7: **B60R 22/46**

(21) Application number: **00966469.9**

(86) International application number:
PCT/JP00/07116

(22) Date of filing: **13.10.2000**

(87) International publication number:
WO 01/26938 (19.04.2001 Gazette 2001/16)

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE**

(72) Inventor: **AMANO, Junya**
Himeji-shi, Hyogo 679-2122 (JP)

(30) Priority: **14.10.1999 JP 29176599**
14.10.1999 JP 29176699

(74) Representative: **Briat, Sophie et al**
Cabinet Beau de Loménie
158, rue de l'Université
75340 Paris Cedex 07 (FR)

(71) Applicant: **Nippon Kayaku Kabushiki Kaisha**
Tokyo 102-8172 (JP)

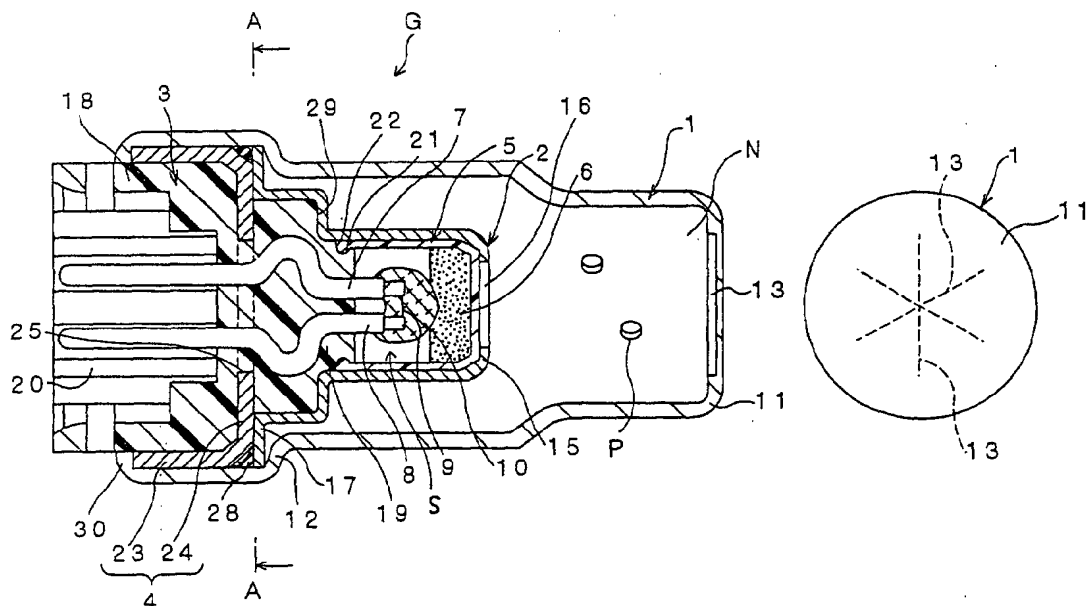
(54) **GAS GENERATOR**

(57) A gas generator G of the present invention has a construction in which a holder 3, 73 is fitted into a cup case 1, 71 and a tube-like case 2 or a container body 72 and enclose gas generants P and ignition agents 6, 76.

The holder 3, 73 is formed of resin. A metallic reinforcement 4 is integrated with the resin holder 3 by insert molding.

Or, a ring body 74 for sealing the cup case 71 and the holder 73 is mounted on the holder 73.

FIG. 1



EP 1 227 016 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a gas generator for actuating a seat belt pretensioner of an automobile.

BACKGROUND ART

[0002] A seat belt pretensioner is known as a safety system for protecting occupants in an automobile from an impact generated in a collision of the automobile. The pretensioner is actuated by a large amount of gas introduced by a gas generator and subsequently protects the occupants. The gas generator includes a squib as an ignitor, gas generants and the like. By ignition of the squib in the collision, the gas generants fire and burn then generates a large amount of gas rapidly.

[0003] As an example of conventional gas generators, a gas generator shown in Fig. 11 has been proposed. The gas generator shown in Fig. 11 includes a cup case 51 in a shape of cylinder with a bottom loaded with gas generants 52, a tube-like case 54 housing ignition charge 53, and a holder 55 of which some parts are fitted in the cup case 51 and the tube-like case 54 respectively to seal the cup case 51 containing the gas generants 52 in its inside and the tube-like case 54 containing the ignition charge 53 in its inside. The holder 55 is made of resin. The holder 55 is integrally provided with a squib 56 for igniting the ignition charge 53. The squib 56 includes two electrode pins 57, 58 penetrating the holder 55 and projecting within the tube-like case 54, a bridge wire 59 welded to the respective electrode pins 57, 58 in the tube-like case 54, and an fuse head 60 covering the bridge wire 59 and being in contact with the ignition charge 53.

[0004] In this gas generator, the parts of the holder 55 is inserted in an opening of the cup case 51. An end portion of the cup case 51 on the opening side is crimped in crimping groove 63 so that the end portion comes into contact with a sealing ring 61 flexibly in the crimping groove 63 of the holder 55. Thus, the cup case 51 is sealed by the holder 55. Further, an end portion on an opening side of the tube-like case 54 is supported on the holder 55 by means of an inner cylindrical member 62 fitted in the cup case 51. As a result, the tube-like case 54 comes into close contact with the holder 55 then an inside space of the tube-like case 54 is tightly shut out.

[0005] In the gas generator of the above-mentioned construction, when electric current is passed through the respective electrode pins 57, 58 of the squib 56, the bridge wire 59 generates heat then the fuse head 60 ignites. The fuse head 60 fires the ignition charge 53. A flame of ignition of the squib 56 is ejected into the cup case 51. The gas generants 52 are ignited and burned by the flame then a large amount of gas generates rapidly.

idly.

[0006] However, since this type of conventional gas generator has a construction where the cup case 51 and the holder 55 are sealed by the crimping portion, there is an adverse possibility that a crimping force acts on the holder 55 then the holder 55 is deformed. A lack of high accuracy in the crimping position of the cup case 51 causes direct press and deformation to the holder. The deformation of the holder 55 generates gaps between the holder 55 and the respective electrode pins 57, 58 and the like. Water and the like go into the tube-like case 54 from the gaps then deteriorate the ignition charge 54, the fuse head 60 and the like. Therefore, performance of the gas generator is not ensured over a long period of time of use.

[0007] Further, the cup case 51 and the holder 55 are sealed by crimping portion of the cup case 51 and the sealing ring and the like, and the tube-like case 54 and the holder 55 are sealed by a cup member 62. Therefore, a number of members for sealing the above-mentioned components increases. As a result, cost of manufacture of the gas generators cannot be reduced.

[0008] It is an object of the present invention to provide a gas generator for use in occupant safety systems such as seat belt pretensioner, which has excellent durability, and of which cost of manufacture is reduced.

Disclosure of the Invention

[0009] A gas generator comprises a cup case loaded with gas generants generating gas by combustion, a tube-like case arranged inside of the cup case to contain ignition charge ignited by electric current, a holder made of resin and fitted in both the cup case and the tube-like case for enclosing the gas generants and the ignition charge, and a reinforcement integrated with the resin of the holder by insert molding.

[0010] According to the present invention having the above described construction, even when the holder made of resin, a deformation of the holder caused by a crimping force for connecting the cup case to the holder is restrained by the reinforcement. Also, a deformation of the holder caused by thermal expansion is restrained by the reinforcement.

[0011] Therefore, it is prevent that the gaps arise by deformation of the holder. And, water and the like do not enter the tube-like case. As a result, performance of the gas generator is ensured over a long period of time of use.

[0012] Further, the gas generator of the present invention is preferably constructed as follows. The reinforcement has a protruding portion from an outer periphery of the holder. The protruding portion is fitted into the cup case. Inter-gaps among of the cup case, the tube-like case and the holder are tightly closed by means of crimping force between the protruding portion and the cup case.

[0013] Since the crimping force acts between the cup

case and the protruding portion of the reinforcement, high accuracy in crimping position is not required. Since a simple crimping construction between the cup case and the reinforcement enables the inter-gaps among of the cup case, the tube-like case and the holder to be integrally and tightly closed, a number of sealing members such as sealing rings is decreased. Also, strength of the holder is increased by the reinforcement. Therefore, a gas generator can be provided, which has an excellent durability and of which cost for manufacturing is reduced,

[0014] Additionally, the gas generator of the present invention is preferably constructed as follows. The tube-like case has a flange protruding towards the cup case, the flange is sandwiched in between the cup case and the protruding portion of the reinforcement.

[0015] The reinforcement restrains that the crimping force acts on the resin of the holder directly, and prevents the holder from deforming.

[0016] Also, the gas generator of the present invention is preferably constructed as follows. The reinforcement consists of a cylindrical body and a ring plate so as to be in cup shape. The cylindrical body protrudes from the outer periphery of the holder. The ring plate is integrated with resin of the holder.

[0017] The reinforcement constructed above enables the strength of the holder to increase, and connecting the cup case to the holder with caulking to be easy.

[0018] Another gas generator of the present invention comprises a cup case loaded with gas generants generating gas by combustion, a tube-like case arranged inside of the cup case to contain ignition charge ignited by electric current, a holder made of resin and fitted in both the cup case and the tube-like case for enclosing the gas generants and the ignition charge, and a ring body mounting fixedly on a part of outer periphery of the holder so that an inter-gap between the cup case and the holder is tightly closed.

[0019] According to the present invention having the above described construction, high accuracy in a crimping position between the cup case and the holder is not required. The inter-gap between the cup case and the holder is tightly closed by means of a simple operation in which the ring body mounting fixedly on the part of outer periphery of the holder.

[0020] In addition, according to the present invention, since a crimping force does not act on the cup case directly, it is restrained that the crimping force acts on the resin of the holder through the cup case. Deformation of the holder is thereby prevented.

[0021] As a result, a cost for manufacturing the gas generator is decreased. Also, it is prevented that gaps arise by deformation of the holder. Therefore, water and the like do not enter the tube-like case, a performance of the gas generator is ensured over a long period of time of use. A gas generator can be provided, which has an excellent durability and of which cost for manufacture is reduced.

[0022] Further, in the gas generator of the present invention, a sealing layer is preferably provided among the ring body, the cup case and the holder.

[0023] The sealing layer improves a seal property among of the ring body, the cup case and the holder. As a result, a gas generator with more excellent durability can be provided.

Brief Description of the Drawings

[0024] Fig. 1 is a built-up sectional view showing a gas generator of the present invention; Fig. 2 is an exploded sectional view showing a gas generator of the present invention; Fig. 3 is a sectional view, taken on line A-A of Fig. 1; Fig. 4 is an enlarged sectional view of a principle part of Fig. 1; Fig. 5 is a built-up sectional view showing a first variant of a gas generator of the present invention; Fig. 6 is a built-up sectional view showing a second variant of a gas generator of the present invention; Fig. 7 is a built-up sectional view showing another gas generator of the present invention; Fig. 8 is an exploded sectional view showing a gas generator of the present invention; Fig. 9 is an enlarged sectional view of a principle part of Fig. 7; Fig. 10 is a built-up sectional view showing a variant of a gas generator of the present invention; Fig. 11 is a sectional view showing a conventional gas generator.

BEST MODE FOR CARRYING OUT THE INVENTION

[0025] An embodiment of a gas generator of the present invention will be given with reference to the drawings.

[0026] A gas generator G shown in Figs. 1 and 2 is what actuates a pretensioner for seat belts of an automobile. Gas generants P are burned by ignition of a squib S then a large amount of gas generates rapidly. The gas generator G includes a cup case 1, a tube-like case 2, and a holder 3 in addition to the squib S and the gas generants P. The holder 3 is made of resin by insert molding. A reinforcement 4 is integrated with the holder 3 so as to cover an outer surface of the holder 3. In the gas generator G of the present invention, for the purpose of crimping, an edge of the cup case 1 on an opening side is bent onto the reinforcement 4 so as to cover an outer periphery of the reinforcement 4. Thereby, the cup case 1 is sealed up. And then, inter-gaps among of the cup case 1, the tube-like case 2 and the holder 3 are tightly closed at the same time. The squib S includes ignition charge 6, two electrode pins 7, 8, a bridge wire 9, an fuse head 10 and a container body 5. The container body 5 has a cylindrical shape with a bottom for containing the ignition charge 6, leading edges of the two electrode pins 7, 8, the bridge wire 9 and the fuse head 10. And the squib S is integrated with the holder 3.

[0027] The cup case 1 of the gas generator G has a cylindrical shape with a bottom, of which a diameter becomes large in step-by-step, and made of metal mate-

rials such as stainless or aluminum. The cup case 1 is loaded with the gas generants P that generate gas by combustion. Step portions are formed in the cup case 1, of which diameters increase from the bottom 11 side towards the opening side. A plurality of notches 13 (e. g. six notches in Fig. 1) are formed with the bottom 11 of the cup case 1. Each of the notches 13 is radially arranged from an axis of the cup case 1 and carved with a predetermined depth within the cup case 1. When the bottom 11 of the cup case 1 is partially spread in accordance with an increase of internal pressure in the cup case 1, the notches 13 form a gas discharge hole so as to communicate the inside and an outside of the cup case 1.

[0028] The tube-like case 2 is made of metal materials such as stainless or aluminum and formed into a cylindrical shape, which disposed within the cup case 1. The cylindrical tube-like case 2 is a cylinder of which a diameter increases in step-by-step. One opening of the tube-like case 2 on a smaller diameter side is an inflammation hole 16. A flange 17 is formed at an end portion of the tube-like case 2 on a larger diameter opening side as a portion projecting until a step portion 12 of the cup case 1. The flange 17 abuts the step portion 12 within the cup case 1 and forms a combustion chamber N for the gas generants P with the cup case 1. The container body 5 of the squib S is inserted in the tube-like case 2 until the inflammation hole 16 is closed by the container body 5. The ignition charge 6 are contained in the container body 5.

[0029] The holder 3 includes a holder's main body 18 and a shaft body 19 of which diameter decreases with two-stages from the holder's main body 18. Therefore, a shape of the holder 3 has shoulder portions. The shaft body 19 is fitted in the opening of the tube-like case 2. A fitting hole 20 for a plug is formed in the holder's main body 18, which opens toward an opposite side to the shaft body 19. A tip portion of the shaft body 19 is inserted in the container body 5. The tip of the shaft body 19 has a fitting groove 22 in which a protrusion 21 on an opening side of the container body 5 is fitted. The holder 3 is made by means of injecting resin containing glass fibers and the like into a mold (not shown). As examples of the resin, there are polybutylene terephthalate, polyethylene terephthalate, nylon 6, nylon 66, polyphenylene sulfide, and polyphenylene oxide.

[0030] Electrode pins 7, 8 of the squib S and a reinforcement 4 are integrated with the holder 3. Such holder is obtained by the following insert molding. The respective electrode pin 7, 8 and the reinforcement 4 are prepared in the above-mentioned mold in advance. Then, resin is injected into the mold. The resinous holder 3 integrally formed with the electrode pins 7, 8 and the reinforcement 4 is hereby obtained.

[0031] The respective electrode pin 7, 8 is arranged in parallel with an axis of the gas generator G and penetrates the shaft body 19 of the holder 3. The respective electrode pin 7, 8 has a curvature shape in the shaft

body 19. And the respective electrode pin 7, 8 protrudes in the fitting hole 20 of the holder's main body 18 and the container body 5. The respective electrode pin 7, 8 is made of conductive materials such as stainless, iron-nickel alloy and electrically insulated by the resin of the holder 3. Further, the bridge wire 9 is welded to the respective electrode pin 7, 8 in the container body 5 by welding and the like. The fuse head 10 is formed so as to cover tip portions of the respective electrode pin 7, 8 and the bridge wire 9. And the fuse head 10 is in contact with the ignition charge 6 in the container body 5. Thus, the holder 3 is integrally provided with the squib S which includes the container body 5, the ignition charge 6, the respective electrode pin 7, 8 and the like.

[0032] As examples of materials of the reinforcement 4, there are metal materials such as stainless and SPCC and reinforced plastics such as heat curing resin and the like. The reinforcement 4 is formed so as to have a cup shape with a cylindrical body 23 and a ring plate 24. The cylindrical body 23 covers an outer periphery of the holder's main body 18 so as to be a protruding portion. And the ring plate 24 is substantially perpendicularly connected to the cylindrical body 23. A corner of junction in which the cylindrical body 23 and the ring plate 24 are connected, is chamfered.

[0033] The ring plate 24 is located between the holder's main body 18 and the shaft body 19, and perpendicular to the respective electrode pins 7, 8. One portion on an inner periphery side of the ring plate 24 is integrated with the resin holder 3. Other portion on outer periphery side of the ring plate 24 is partially exposed to an out of the holder 3. The portion of the ring plate 24 exposed to the out of the holder 3 constructs the protruding portion with the cylindrical body 23. As shown in Fig. 3, the respective electrode pin 7, 8 passes through in an inner periphery hole 25 of the ring plate 24.

[0034] The gas generator G constructed as thus is manufactured in the following steps.

[0035] The resinous holder 3 is obtained by the following insert molding, which is integrated with the respective electrode pin 7, 8 and the reinforcement 4. The respective electrode pins 7, 8 and the reinforcement 4 are set in a mold for molding the holder 3 in advance. Resin is injected into the mold. The resinous holder 3 is obtained, which is integrated with the respective electrode pin 7, 8 and the reinforcement 4.

[0036] Then, the bridge wire 9 is welded to the respective electrode pin 7, 8 and covered with the fuse head 10. The ignition charge 6 is contained in the container body 5. The shaft body 19 of the holder 3 is fitted into the container body 5, thereby the squib S and the holder 3 are integrated.

[0037] Then, a sealing ring 28 is mounted on the chamfered corner portion of the outer periphery side of the reinforcement 4 of the holder 3. The container body 5 of the squib S of the holder 3 is fitted into the tube-like case 2 until the container body 5 touches a bottom 15 of the tube-like case 2 so as to close the inflammation

hole 16 of the tube-like case 2. The shaft body 19 of the holder 3 is inserted into the tube-like case 2 until the shaft body 19 touches a step portion 29 of the tube-like case 2 so that the flange 17 of the tube-like case 2, the ring plate 24 and the sealing ring 28 are touched by one another. Thus, the shaft body 19 of the holder 3 is fitted in an opening of the tube-like case 2. The tube-like case 2 is thereby assembled on the holder 3.

[0038] Then, the tube-like case 2 assembled on the holder 3 is fitted into the cup case 1. The holder 3 is inserted into the cup case 1 until the flange 17 of the tube-like case 2 abuts the step portion 12 inside of the cup case 1. The cylindrical body 23 of the reinforcement 4 is fitted in the opening of the cup case 1. The gas generator G is thereby assembled.

[0039] Hereby, the tube-like case 2 and the container body 5 of the squib S, etc. are accommodated in the cup case 1. The tube-like case 2 and the cup case 1 construct the combustion chamber N. The flange 17 of the tube-like case 2 is located between the step portion 12 of the cup case 1 and the ring plate 24. In other words, the step portion 12 of the cup case 1, the flange 17 of the tube-like case 2 and the ring plate 24 are arranged in this order from the bottom 11 of the cup case 1 and touch one another.

[0040] In the above-mentioned condition, as shown in Fig. 4, an edge on the opening side of the cup case 1 is bent towards the holder 3 for the purpose of crimping. The cylindrical body 23 of the reinforcement 4 is folded by the bent portion 30 and the step portion 12 with crimping force.

[0041] Thereby, the step portion 12 and the flange 17 of the tube-like case 2 are pushed towards the ring plate 24 by the crimping force, then the sealing ring 28 is deformed. Inter-gaps among of the cup case 1, tube-like case 2 and the ring plate 24 are tightly closed.

[0042] Even when the crimping force acts on the holder 3 through the flange 17 of the tube-like case 2, the reinforcement 4 consist of the ring plate 24 and the cylindrical body 23 prevents the holder 3 from deforming.

[0043] In the gas generator G, electric current flows through the electrode pins 7, 8, and heat generated in the bridge wire 9 ignites the fuse head 10 then the ignition charge 6 are subsequently fired. A flame of ignition of the squib S is ejected into the cup case 1. The gas generants P are ignited and burned by the flame, then a large amount of gas generated. In succession, the large amount of gas is introduced from the cup case 1 to the above-mentioned seat belt pretensioner through the gas discharge hole which opens by means of rupture at the notches 13 of the bottom 11 in accordance with an increase of an internal pressure in the cup case 1. The seat belt pretensioner is actuated by the high pressure gas then fasten seat belts.

[0044] In the gas generator G of the present invention, the reinforcement 4 prevents the holder 3 from being deformed by the crimping force even if the holder 3 was formed of resin. Also, the reinforcement 4 prevents the

holder 3 from being deformed by a thermal expansion. Particularly, a construction in which the flange 17 of the tube-like case 12 touches the ring plate 24 of the reinforcement 4, prevents the crimping force from acting on the resin of the holder 3 directly. Therefore, it is prevented that gaps arise by the crimping force, thermal expansion and the like. Accordingly, it is also prevented that water and the like enters the tube-like case 2 and the like. As a result, performance of the gas generator G is ensured over a long period of time of use.

[0045] In the gas generator G of the present invention, since the crimping force acts between the cup case 1 and the reinforcement 4 of the holder 3, a high accuracy in crimping position is not required. Therefore, by a simple construction of the present invention, the inter-gaps among of the cup case 1, the tube-like case 2 and the holder 3 are tightly closed.

[0046] Since the inter-gaps among of the cup case 1, the tube-like case 2 and the holder 3 are integrally sealed by the crimping force acting substantially between the cup case 1 and the reinforcement 4, a number of crimping members such as sealing rings can be decreased. Therefore, the gas generator G can be provided, which has an excellent durability and of which cost for manufacturing is reduced.

[0047] The gas generator G having the cup-shaped reinforcement 4 has been described. However, the gas generator G is not limited to the above-mentioned gas generator. The reason in which the reinforcement 4 is formed into a cup shape, is that a strength of the holder 3 is increased by the ring plate 24 and the cup case 1 mounts and is fixed on the cylindrical body 23 easily by crimping force. Standing at these points, the reinforcement shown in Figs. 5 and 6 may be adopted.

[0048] A reinforcement 4 shown in Fig. 5 is only formed with a ring plate 35. An outer periphery side of the ring plate 35 protrudes from the holder 3 so as to form a protruding portion 37 and an inner periphery side thereof is integrated with the resin of the holder 3. In a condition in which the protruding portion 37 of the ring plate 35 is fitted in an opening of the cup case 1, an edge of the cup case 1 on the opening side is bent towards the holder 3 for the purpose of crimping. The protruding portion 37 of the ring plate 35 is folded by the bent portion 30 and the step portion 12 with crimping force. Thereby, inter-gaps among of the cup case 1, the tube-like case 2 and the holder 3 are tightly closed.

[0049] Fig. 5 shows a construction in which the flange 17 of the tube-like case 2 abuts the holder's main body 18 without touching the protruding portion 37 of the ring plate 35. However, a construction may be adopted, in which the protruding portion 37 of the ring plate 35 touches the flange 17 of the tube-like case 2.

[0050] A reinforcement 4 shown in Fig. 6 is only formed with a cylindrical body 36. An outer periphery side of the cylindrical body 36 protrudes from the holder 3 so as to form a protruding portion 38 and an inner periphery side thereof is integrated with the resin of the

holder 3. In a condition in which the protruding portion 38 of the cylindrical body 36 is fitted in an opening of the cup case 1, an edge of the cup case 1 on an opening side is bent towards the holder 3 for the purpose of crimping. The protruding portion 38 of the cylindrical body 36 is folded by the bent portion 30 and the step portion 12 with crimping force. Thereby, inter-gaps among of the cup case 1, the tube-like case 2 and the holder 3 are tightly closed.

[0051] Fig. 6 shows a construction in which the flange 17 of the tube-like case 2 touches the holder's main body 18 without touching the protruding portion 38 of the cylindrical body 36. However, a construction may be adopted, in which the protruding portion 38 of the cylindrical body 36 touches the flange 17 of the tube-like case 2.

[0052] Further, the another embodiment of the present invention will be given with reference to the drawings.

[0053] Similarly to the above-mentioned gas generator, gas generators G for actuating a pretensioner for seat belt of an automobile are shown in Figs. 7 and 8. In addition to a squib S and gas generants P, the respective gas generator G includes a cup case 71 in a cylindrical shape with a bottom loaded with the gas generants P, a container body 72 in a cylindrical shape with a bottom included in the squib S, a holder 73, and a ring body 74 for crimping. The holder 73 is made of resin. In the gas generator G, inter-gap between the cup case 71 and the holder 73 is tightly closed by using the ring body 74 for crimping. The squib S includes ignition charge 76, two electrode pins 77, 78, a bridge wire 79 and an fuse head 80 in addition to the container body 72. The squib S is integrated with the holder 73.

[0054] The cup case 71 of the gas generator G is made of metal materials such as stainless or aluminum into a cup shape and loaded with the gas generants P that generate gas by combustion. A diameter of the cup case 71 increases from a bottom 81 side to an opening side with step portions. A flange 82 is integrally formed on an opening portion of the cup case 71, which extends in an outwardly radial direction of the cup case 71. A plurality of notches 83, e.g. six notches, are formed on the bottom 81 of the cup case 71, which are radially arranged at an axis of the cup case 71 and notched with a predetermined depth inside of the cup case 71. The notches 83 enable a gas discharge hole to open on the bottom 81 in accordance with an increase of an internal pressure in the cup case 71. Thereby, the inside and outside of the cup case 71 are communicated through the gas discharge hole.

[0055] The container body 72 is disposed inside of the cup case 71. The container body 72 is, for example, made of resin into a cup shape and contains the ignition charge 76. An annular protrusion 94 is integrally formed at an opening portion of the container body 72, which protrudes in the inwardly radial direction of the container body 72.

[0056] The holder 73 has a holder's main body 88 and a shaft body 89 integrally. A fitting hole 90 for a plug is formed in the holder's main body 88, which opens towards a side opposite to a shaft body side. A diameter of the shaft body 89 decreases from a holder's main body side to a tip end side thereof with three stages. Therefore, a shape of the shaft body 89 has shoulder portions, a mounted shaft 91 mounted by the ring body 74, an inserted shaft 92 inserted into the cup case 71 and a fitted shaft 93 fitted into the container body 72. An annular fitting groove 97 is formed on the fitted shaft 93 of the shaft body 89, in which the protrusion 94 of the container body 72 is fitted. The holder 73 is preferably formed by injecting resin containing glass fibers and the like into a mold (not shown). As examples of the resin, there polybutylene terephthalate, polyethylene terephthalate, nylon 6, nylon 66, polyphenylene sulfide, polyphenylene oxide and the like.

[0057] The holder 73 is integrally provided with electrode pins 77, 78, a bridge wire 79 and an fuse head 80 in addition to the container body 72 of the squib S and the ignition charge 76. The holder 73 is formed by the following insert molding. The electrode pins 77, 78 are set in the above-mentioned mold in advance. Then resin is injected into the mold. As a result, the resinous holder 73 is obtained, which is integrated with the electrode pins 77, 78.

[0058] The electrode pins 77, 78 are arranged in parallel to an axis of the holder 73 and penetrate shaft body 89 of the holder 73. The respective electrode pin 77, 78 has a curve portion in the shaft body 89 and protrudes into the fitting hole 90 of the holder's main body 88 and the container body 72. The respective electrode pin 77, 78 is made of conductive materials such as stainless or iron-nickel alloy and electrically insulated by the resin of the holder 73. The bridge wire 79 is welded by welding and the like to the respective electrode pin 77, 78 in the container body 72. The bridge wire 79 generates heat when electric current flows through between the electrode pins 77, 78, then the fuse head 80 is ignited. The fuse head 80 is formed so as to cover tip end portions of the respective electrode pin 77, 78 and the bridge wire 79. The fuse head 80 is contacted with the ignition charge 76 in the container body 72.

[0059] The ring body 74 is made of metal materials such as stainless or aluminum and into a cylindrical shape. An inside diameter of the ring body 74 is substantially equal to an outside diameter of the mounted shaft 91. The ring body 74 is mounted on an outer periphery of the mounted shaft 91 of the holder 73 by being press-fitted. Thereby, it is prevented that the ring body 74 falls off from the mounted shaft 91. Because the ring body 74 is connected to the mounted shaft 91 of the holder 73 with friction. For connecting the ring body 74 to the mounted shaft 91 of the holder 73, the following constructions may be adopted as well as the above-mentioned frictional contact. (i) A construction in which an inner periphery of the ring body 74 and an outer pe-

riphery of the mounted shaft 91 have screws-threads respectively, and then the ring body 74 and the mounted shaft 91 are connected each other by threaded engagement 74. (ii) A construction in which the ring body 74 is mounted on an outer periphery of the mounted shaft 91 of the holder 73 then the ring body 74 is coupled to the mounted shaft 91 with a bolt and the like.

[0060] An edge of the ring body 74 on the cup case 71 side is bent towards a flange 82 of the cup case 71 for crimping. And an inter-gap between the cup case 71 and the holder 73 is tightly closed.

[0061] The gas generator G constructed as above is manufactured in the following steps.

[0062] The cup case 71 and the container body 72 are made in advance so as to have cup shapes respectively. Also, the ring body 74 is made in advance so as to have a cylindrical shape. The gas generants P are loaded in the cup case 71 and the ignition charge 76 are loaded in the container body 72. The following insert molding steps are carried out in order to obtain the resinous holder 73 including the electrode pins 77, 78 integrally. The electrode pins 77, 78 are set in a mold in advance. Resin is injected into the mold. The resinous holder 73 is obtained, which is integrated with the respective electrode pin 77, 78. Tip portions of the electrode pins 7, 8, which project from the shaft body 89 of the holder 73, are respectively welded to the bridge wire 79. The fuse head 80 covers the bridge wire 79 and the like.

[0063] Then, the fuse head 80 of the squib S integrated with the holder 73 is inserted into the container body 72. And the fitted shaft 93 of the holder 73 is fitted into the container body 72. The bridge wire 79, the fuse head 80 and the like are contained in the container body 72 under a condition where the fuse head 80 is in contact with the ignition charge 76. The squib S is integrated with the holder 73. The container body 72 of the holder 73 is inserted into the cup case 71. And the inserted shaft 92 is inserted into an opening portion of the cup case 71. At this time, the flange 82 of the cup case 71 touches a first shoulder portion 96 formed between the mounted shaft 91 and the inserted shaft 92 of the holder 73. Thereby, a combustion chamber N is formed. Therefore, the holder 73 is made an enclosed space for containing the gas generants P in the cup case 71 as well as the enclosed space for containing the ignition charge 76 in the container body 72.

[0064] After the holder 73 is fitted into the cup case 71, the cup case 71 is inserted into an opening of the ring body 74. The ring body 74 is mounted on an outer periphery of the mounted shaft 91 of the holder 73 and an outer periphery of the flange 82 of the cup case 71 by press-fitting. One edge of the ring body 74 abuts a second shoulder portion 95 formed between the holder's main body 88 and the mounted shaft 91. Other edge of the ring body 74 protrudes beyond the flange 82 towards the bottom side of the cup case 71 by a predetermined length which enables crimping. (See Fig. 8).

[0065] For the purpose of crimping, as shown in Fig.

9, the other edge portion 75 of the ring body 74 protruding towards the bottom side of the cup case 71 is bent towards the opening side of the cup 71, i.e. the flange 82 side, with crimping force. The flange 82 of the cup case 71 is pushed on the first shoulder portion 96 of the holder 73 by the crimping force. The inter-gap between the cup case 71 and the holder 73 are tightly closed. In the manner described above, the gas generator G is manufactured.

[0066] The crimping force on the ring body 74 is restrained by the metallic flange 82 of the cup case 71, so that the crimping force does not act on the resin of the holder 73 directly then the holder is not deformed.

[0067] In this gas generator G, when electric current flows through the electrode pins 77, 78, heat arises in the bridge wire 79 then ignites the fuse head 80. And subsequently the ignition charge 76 are fired. Flames of the squib S are ejected from the container body 72 into the cup case 71. By the flames, the gas generants P are ignited and burned, then a large amount of gas generates. The large amount of gas generated in the cup case 71 flows into the seat belt pretensioner with a rush through the gas discharge hole which opens by means of that the bottom 81 of the cup case 71 ruptures partially at the respective notch 83 in accordance with increase of internal pressure in the cup case 71. The seat belt pretensioner is actuated by the high pressure gas flowing thereto, then fastens seat belt.

[0068] In the gas generator G of the present invention, even when the holder 73 is made of resin, a gap between the cup case 71 and the holder 73 can be tightly closed by means of a simple crimping operation in which the ring body 74 push onto the flange 82 of the cup case 71 with crimping force without high accuracy in crimping position. In other words, an accuracy in crimping position and precision devices for crimping etc. are not required.

[0069] Instead of a construction in which the end portion of the cup case 71 is directly folded onto the holder 73 for crimping, a construction in which the end portion of the ring body 74 is folded onto the flange 82 of the cup case 71 for crimping, is adopted in the present invention. As a result, it is restrained that a crimping force acts on the resin of the holder 73 directly through the flange 82 of the cup case 71. Thereby deformation of the holder 73 is prevented. Particularly, when the cup case 71 is made of metal material, it is surely prevented that the crimping force acts on the resin of the holder 73 directly.

[0070] As a result, cost for manufacturing the gas generator G is decreased. Also, it is prevented that gaps are made by deformation of the holder 73. Therefore, water and the like does not enter the tube-like case and a performance of the gas generator G is ensured over a long period of time of use. A gas generator with excellent durability, of which cost of manufacture is reduced, can be hereby provided.

[0071] In the gas generator G of the present invention,

tight couplings among of the ring body 74, the cup case 71 and the holder 73 are improved when a sealing layer 100 is provided among of the ring body 74, the cup case 71 and the holder 73 as shown in Figs. 7 and 8. Consequently, the gas generator has an excellent durability. Adhesives such as epoxy resin and silicon tapes etc. may be used as sealing materials for the sealing layer 100. It is preferable to use adhesive as sealing materials in order to strengthen a connection between the ring body 74 and the holder 73.

[0072] Before the ring body 74 is mounted on the holder 73, adhesive is applied to the ring body 74. The sealing layer 100 consisting of the adhesive is formed among of the ring body 74, the cup case 71 and the holder 73. In another case, in advance, an adhesive is applied onto some portions of the holder 73 and the cup case 71. The some portions should be in contact with the ring body 74. After that, the ring body 74 mounts on. Thus, the sealing layer 100 may be formed.

[0073] The ring body 74 is not limited to the ring body made of such metal material as stainless or aluminum. Any ring body 74 may be employed so long as the ring body 74 can be folded towards the opening side of the cup case 71 after fixing on the holder 73 and pushed onto the flange 82 of the cup case 71 for crimping. For example, if the above condition is fulfilled, the ring body 74 may be made of resin.

[0074] Further, a ring body 104 shown in Fig. 10 may be adopted in the gas generator G of the present invention. The ring body 104 shown in Fig. 10 is formed into a cup shape with a cylindrical member 101 and a ring-shaped plate member 102 connected substantially perpendicular to the cylindrical member 101. The ring body 104 is made of metal materials, such as stainless or aluminum, or resin etc.

[0075] The cup case 71 is inserted in the ring body 104 shown in Fig. 10. The cylindrical member 101 mounts on an outer periphery of the mounted shaft 91 of the holder 73. The ring-shaped plate member 102 abuts the flange 82 of the cup case 71 on an opening side thereof. The flange 82 of the cup case 71 is sandwiched in between the ring-shaped plate member 102 of the ring body 104 and the first shoulder portion 96 of the holder 73. Consequently, a gap between the cup case 71 and the holder 73 is closed. At this time, in order to improve the seal property, the following operation may be carried out. The ring-shaped plate member 102 of the ring body 104 is pushed onto the flange 82 of the cup case 71 with crimping force, as an effect, the flange 82 of the cup case 71 is forced onto the holder 73. According to the ring body 104, such an operation of bending the ring body 74 as shown in Fig. 7 towards the opening side of the cup case 71 is omitted. And it is prevented that the resin of the holder 73 is deformed by the bending force. Also, a cost for manufacturing the gas generator G may be decreased since the bending operation is not necessary.

[0076] When a sealing layer 100 such as an adhesive

is formed among of the cylindrical member 101 and the ring-shaped plate member 102 of the ring body 104, the cup case 71 and the holder 73, a seal property is improved as well as described in Fig. 7.

[0077] Further, it is preferable that, in the ring body 104, an inside diameter of the cylindrical member 101 is substantially equal to an outside diameter of a mounted shaft 91 and an inside diameter of the ring-shaped plate member 102 is substantially equal to an outside diameter of the cup case 71 on an opening side thereof. Thereby, when the ring body 104 is mounted on the holder 73, the seal property among of the ring body 104, the cup 71 and the holder 73 is improved by friction contact of the above-mentioned components since the cylindrical member 101 and the plate member 102 are respectively press-fitted on the outer periphery of the mounted shaft 91 and the outer periphery of the cup 71 on the opening side thereof.

20 INDUSTRIAL APPLICABILITY

[0078] The gas generator of the present invention is most suitable for occupant safety systems such as seat belt pretensioner since the present invention has the excellent durability and the manufacturing cost is reduced.

Claims

30 1. A gas generator (G) comprises:

a cup case (1) loaded with gas generants generating gas by combustion,
a tube-like case (2) arranged inside the cup case (1) to contain ignition charge ignited by electric current,
a holder (3) made of resin and fitted in both the cup case (1) and the tube-like case (2) for enclosing the gas generants and the ignition charge, and
a reinforcement (4) integrated with the resin of the holder (3) by insert molding.

2. The gas generator (G) according to claim 1, wherein the reinforcement (4) has a protruding portion from an outer periphery of the holder (3), the protruding portion is fitted into the cup case (1), inter-gaps among the cup case (1), the tube-like case (2) and the holder (3) are tightly closed by means of crimping force between the protruding portion and the cup case (1).

3. The gas generator (G) according to claim 2, wherein the tube-like case (2) has a flange protruding towards the cup case (1), the flange is sandwiched in between the cup case (1) and the protruding portion of the reinforcement (4).

4. The gas generator (G) according to claim 1, wherein
the reinforcement (4) consists of a cylindrical
body and a ring plate to form a cup shape,
the cylindrical body protrudes from the outer
periphery of the holder, 5
the ring plate is integrated with resin of the
holder.
5. A gas generator (G) comprises: 10
a cup case (71) loaded with gas generants gen-
erating gas by combustion,
a tube-like case (72) arranged inside the cup
case to contain ignition charge ignited by elec-
tric current, 15
a holder (73) made of resin and fitted in both
the cup case (71) and the tube-like case (72)
for enclosing the gas generants and the ignition
charge, and
a ring body (74) mounting fixedly on a part of 20
outer periphery of the holder (73) so that an in-
ter-gap between the cup case (71) and the
holder (73) is tightly closed.
6. The gas generator according to claim 5, wherein a 25
sealing layer is provided among of the ring body
(74), the cup case (71) and the holder (73).

30

35

40

45

50

55

FIG. 1

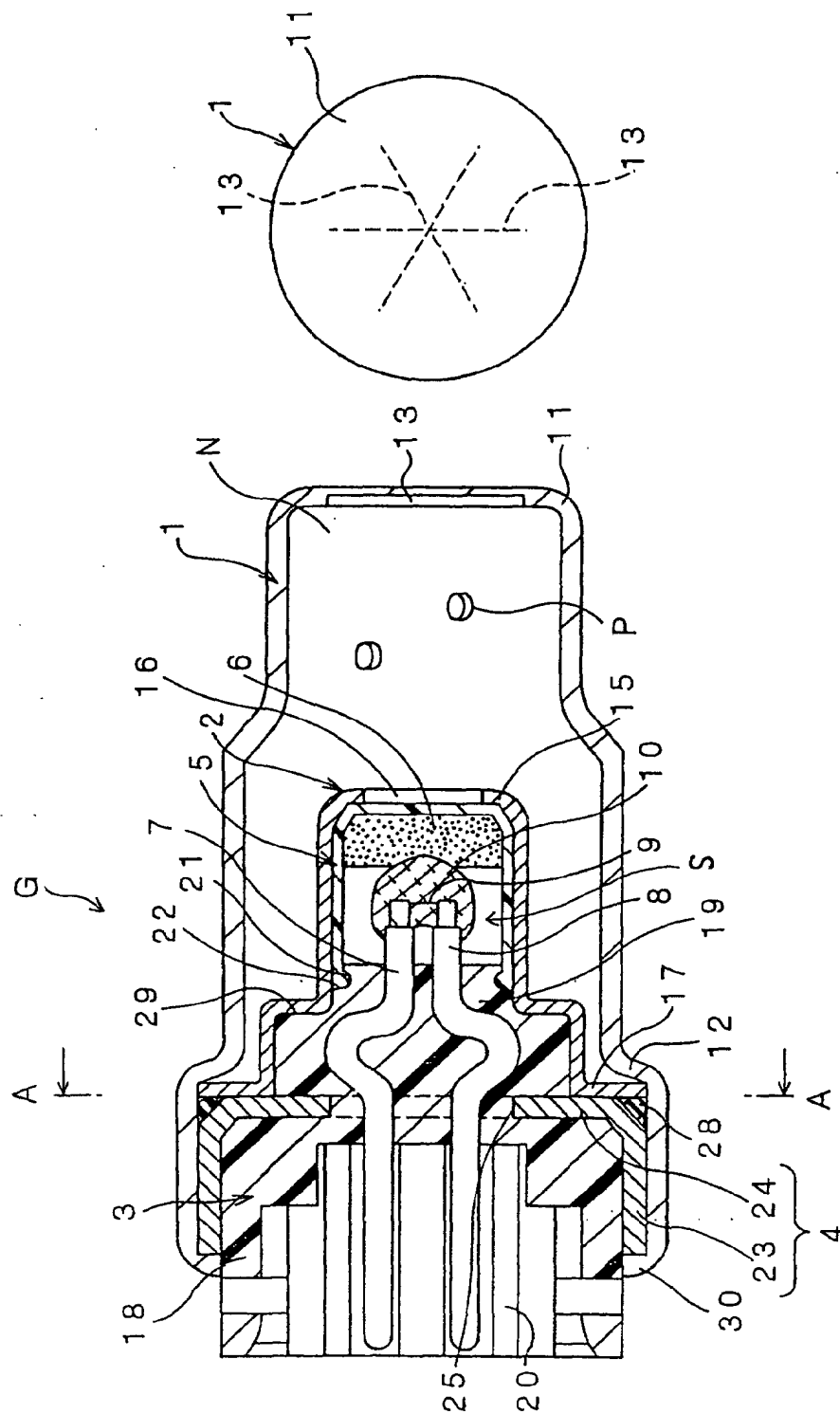


FIG. 2

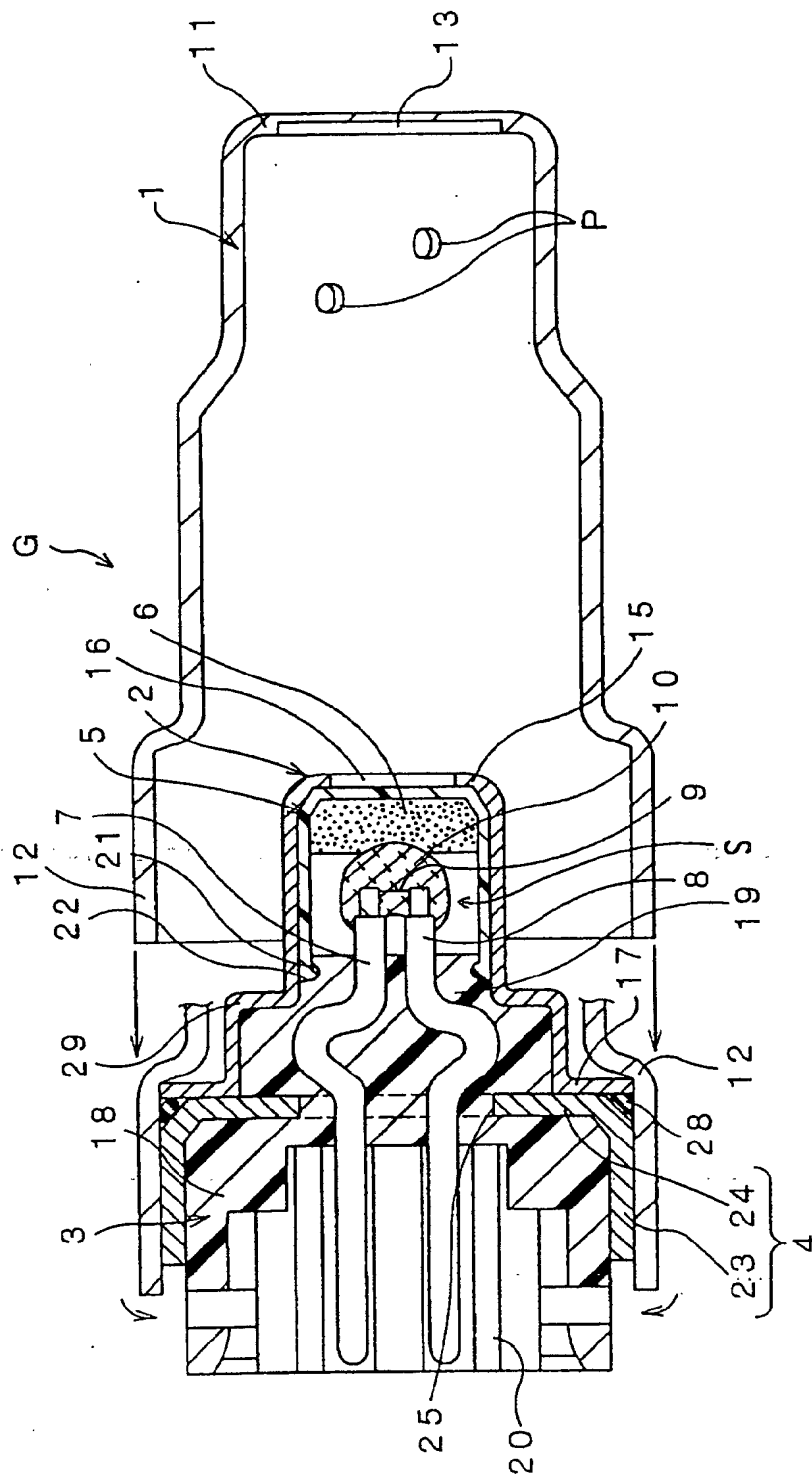


FIG. 3

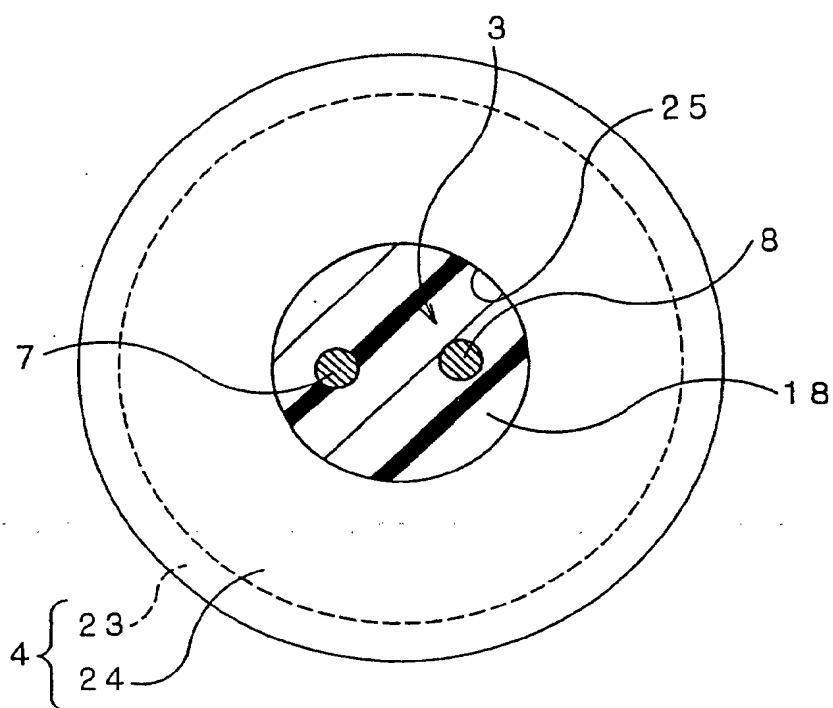


FIG. 4

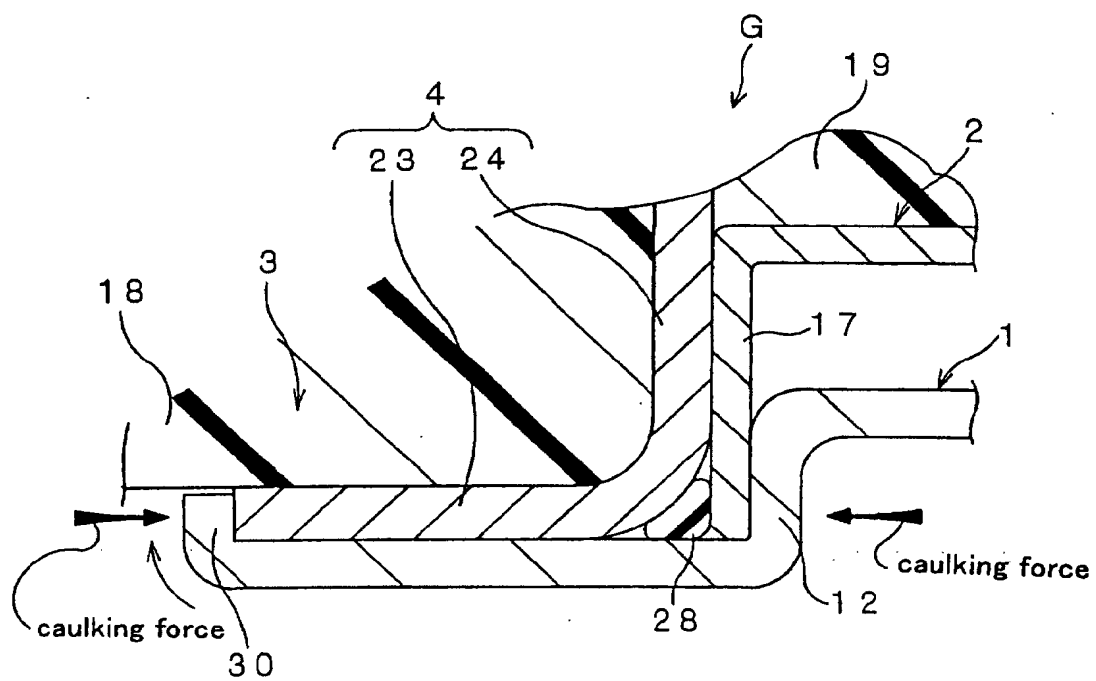


FIG. 5

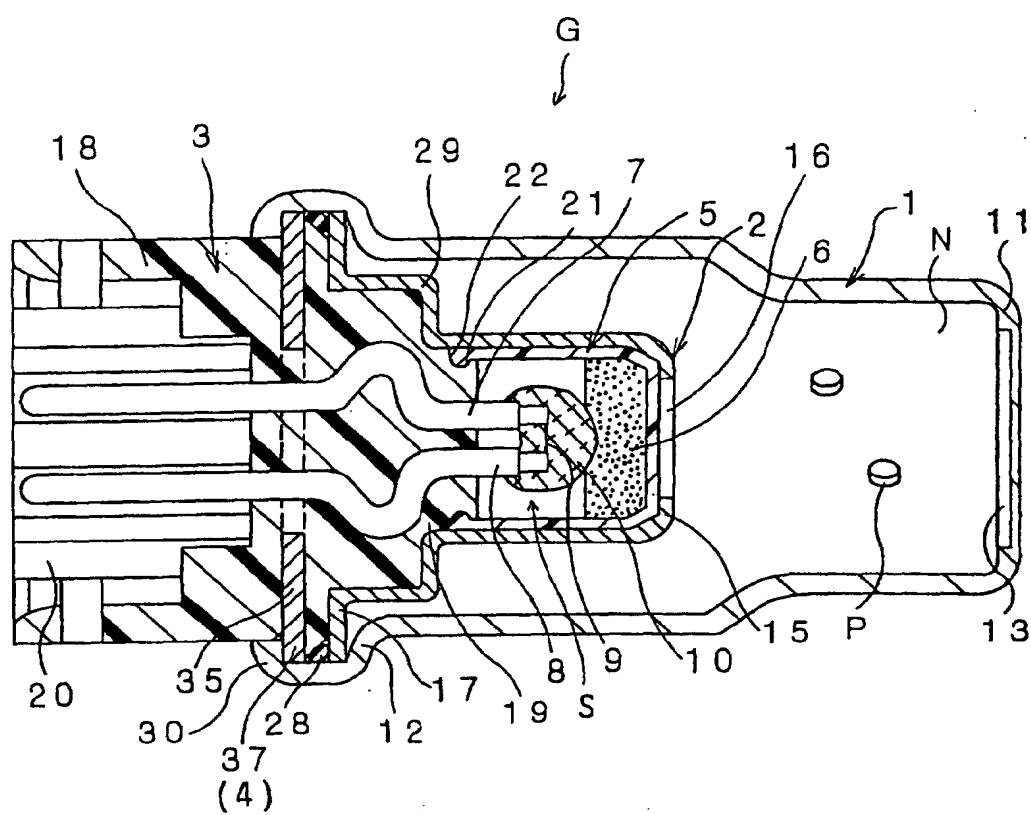


FIG. 6

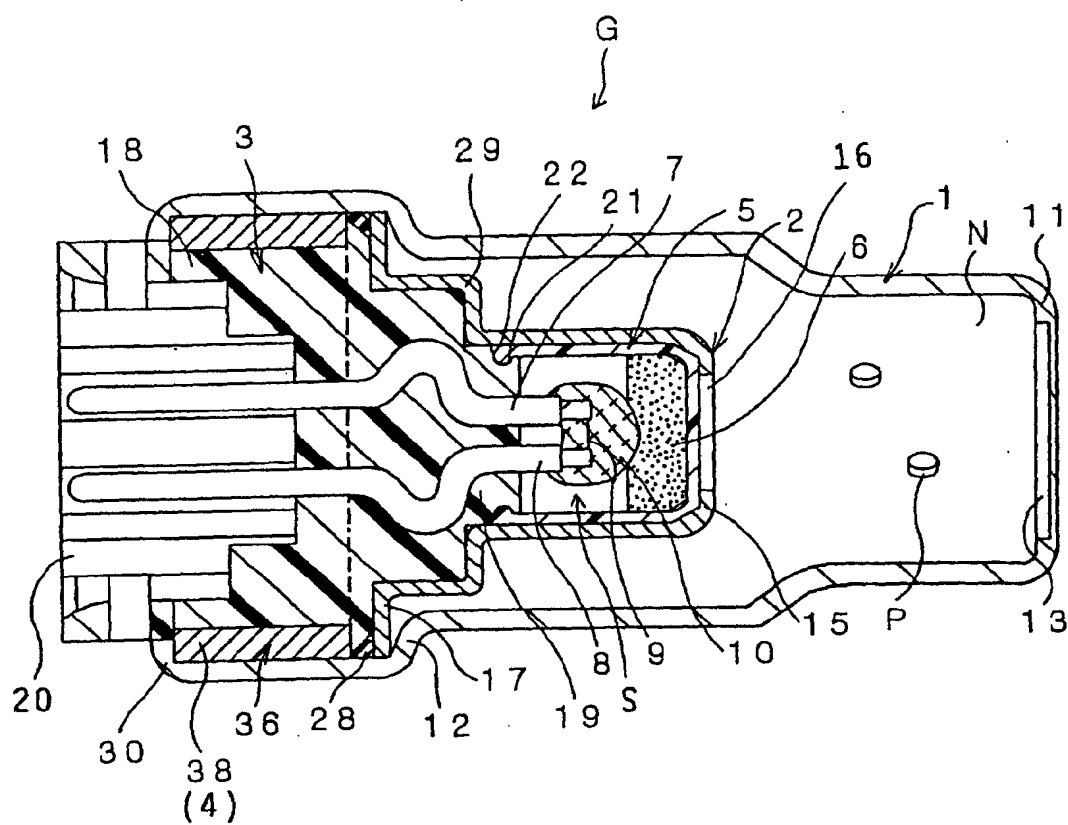


FIG. 7

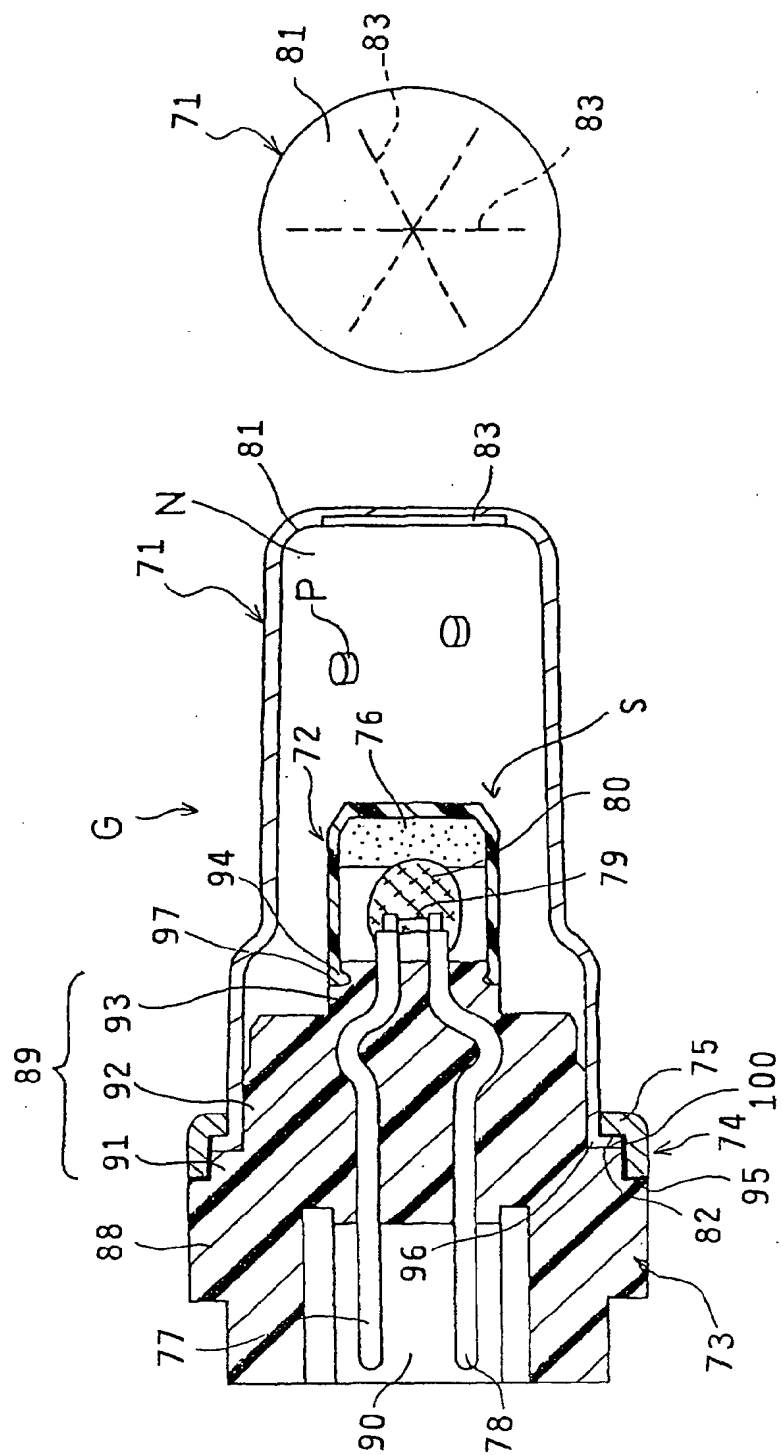


FIG. 8

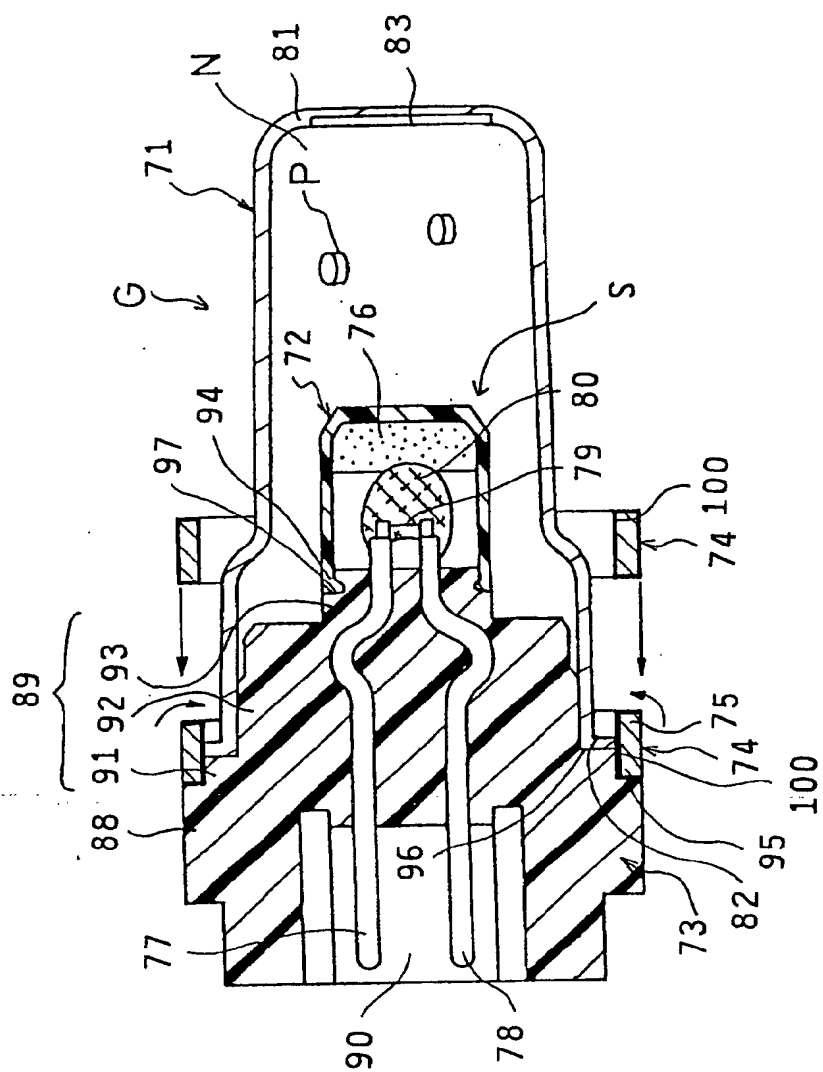


FIG. 9

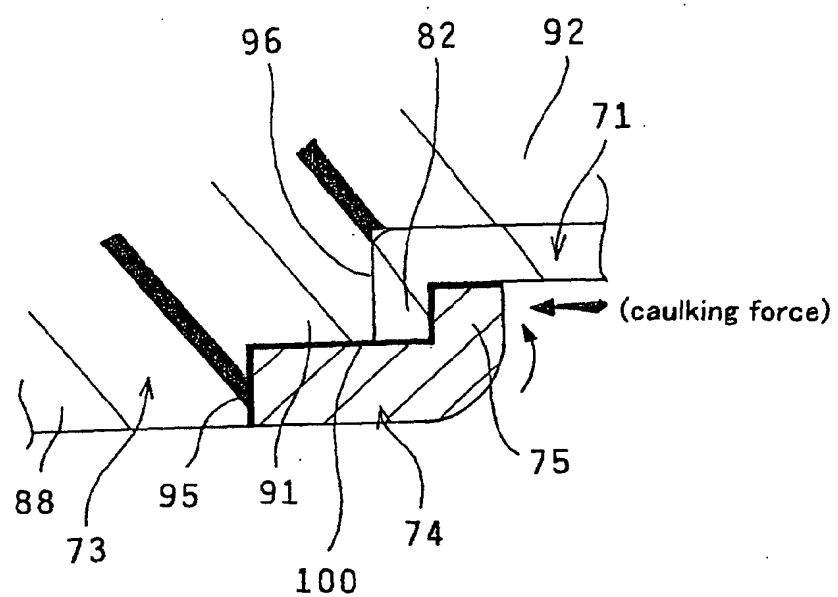


FIG. 10

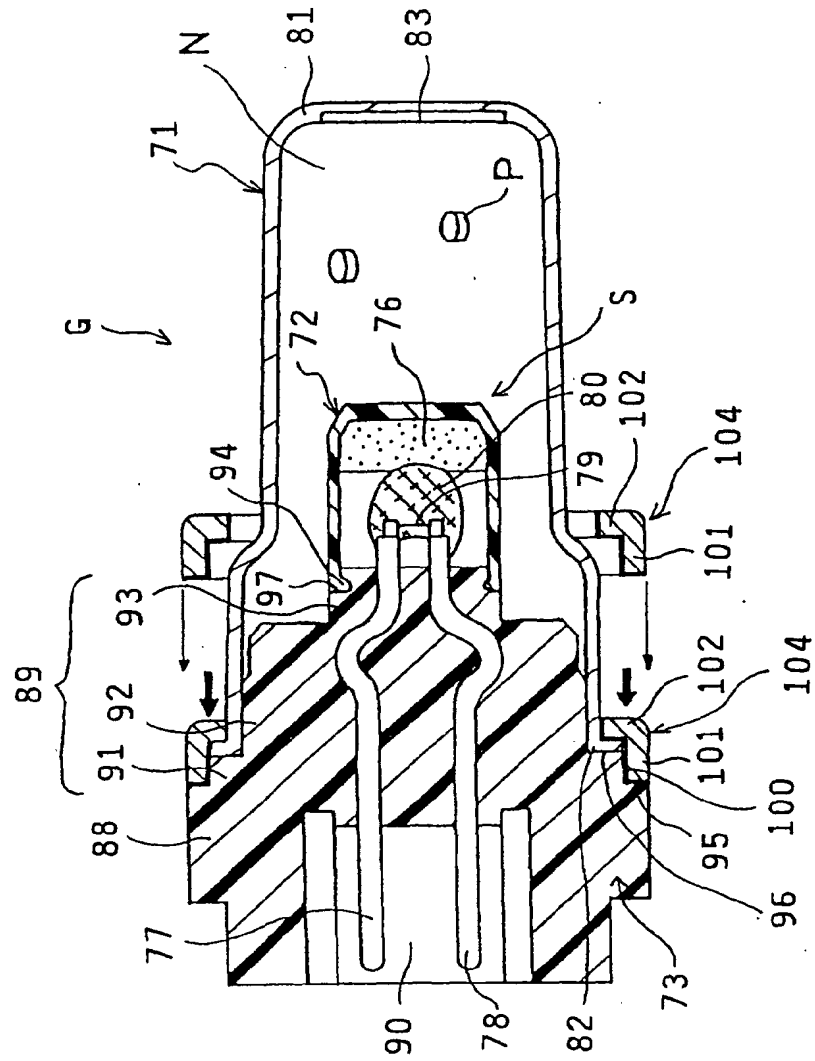
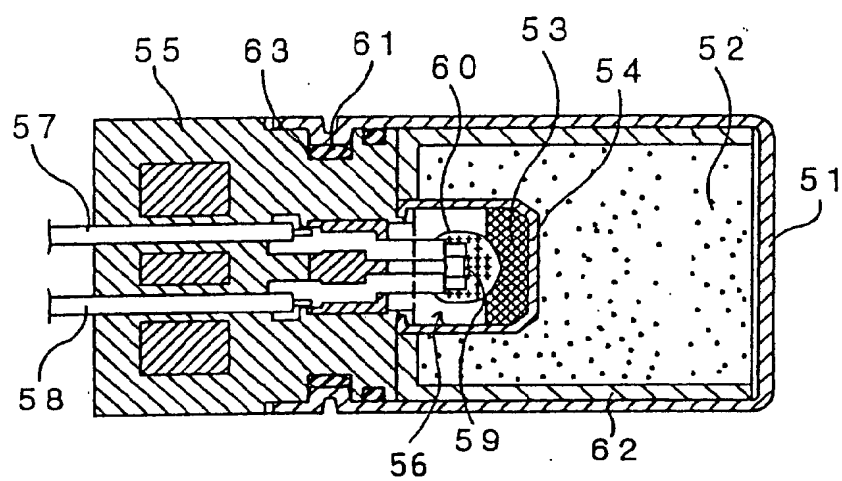


FIG. 11

(Prior Art)



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP00/07116

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl. ⁷ B60R22/46		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) Int.Cl. ⁷ B60R22/46, B60R21/26		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-2001 Kokai Jitsuyo Shinan Koho 1971-2001 Jitsuyo Shinan Toroku Koho 1996-2001		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, 1-301435, A (Bayern Chem. Ges. Flugchem. Anteriebe MBH), 05 December, 1989 (05.12.89), entire document, drawings, (& US, 4959011, A & DE, 3738436, C)	1-6
A	JP, 6-300497, A (Dynamit Nobel AG), 28 October, 1994 (28.10.94), Figs. 3, 6 (& EP, 618424, B1 & US, 5433147, A & DE, 4307774, A)	1-6
A	JP, 9-2204, A (Nippon Koki Co., Ltd.), 07 January, 1997 (07.01.97), Figs. 1, 3 (& EP, 714819, B1 & DE, 69518054, E & WO, 96-00157, A1 & US, 5799977, A)	1-6
A	JP, 11-240412, A (NIPPON KAYAKU CO., LTD.), 07 September, 1999 (07.09.99), Figs. 1, 2 (Family: none)	1-6
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 30 January, 2001 (30.01.01)		Date of mailing of the international search report 21 March, 2001 (21.03.01)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP00/07116

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, 10-217900, A (SNC LIVBAG), 18 August, 1998 (18.08.98), Fig. 2, (& EP, 834716, A1 & FR, 2754050, A1 & US, 5955699, A)	1-6
A	WO, 99-00275, A1 (ATLANTIC RESEACH CORPORATION), 07 January, 1999 (07.01.99), FIG.3 (Family: none)	1-6

Form PCT/ISA/210 (continuation of second sheet) (July 1992)